Material State Management Concepts for Composites

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Problem & Need

- Problem
  - Composites Processing Stuck in the 1960's Due to:
    - Lack of Better Option
      - T.O.'s & Specs Don't Support
      - Path Not Clear for Improved T.O.'s & Specs
  - Industry Consolidation
    - Loss of Continuity as Developers Go Away
- Need
  - Support for Change
  - Extension of Current Projects
  - Application to Shop

Cost of No Action

- Further Entrenchment of Old Technology
- Repair Activities Less Able to Achieve Performance Requirements
- Multiple Repetition of Unneeded Testing for Process Variations
- Qualification of Similar Materials Remains High (Multi-Million $$)
- Precludes Many Avenues for Cost and Performance Improvement

Material State Management (MSM) Vision

For Composites, Adhesives,Sealants

Change Process Goals

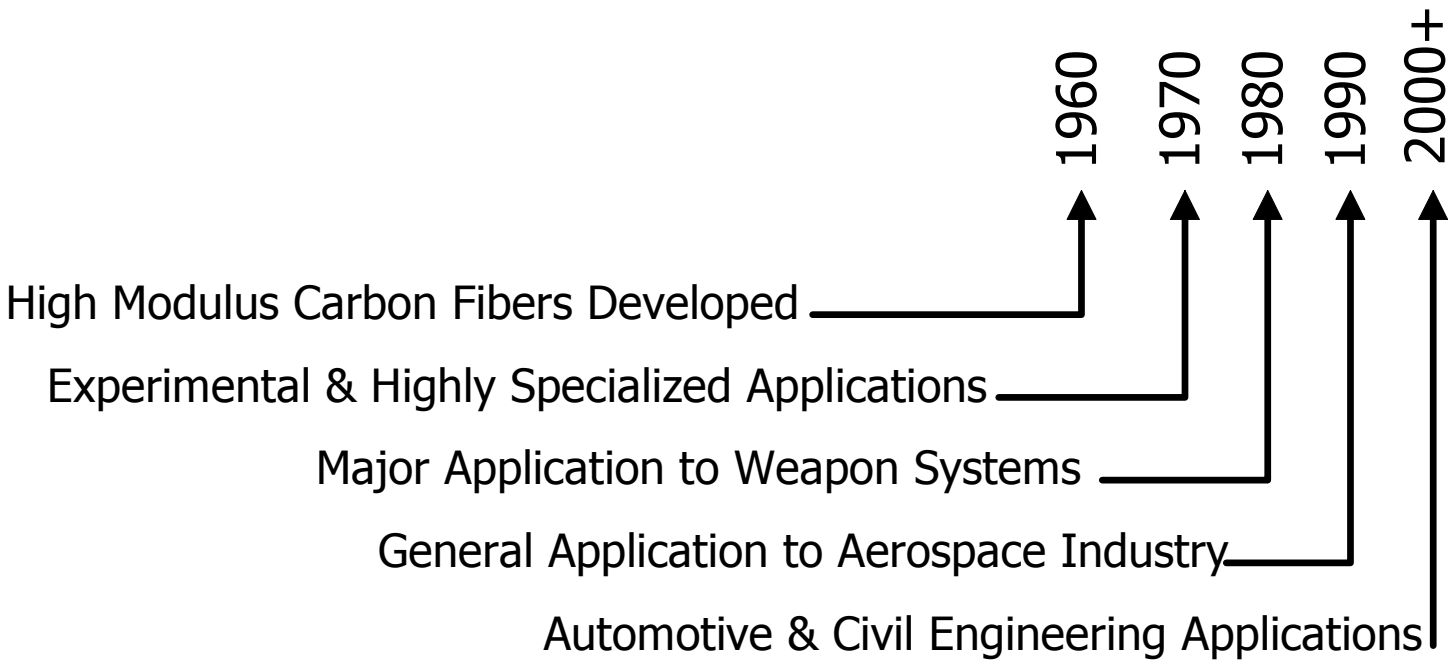
From:

Time and Temperature Cycles

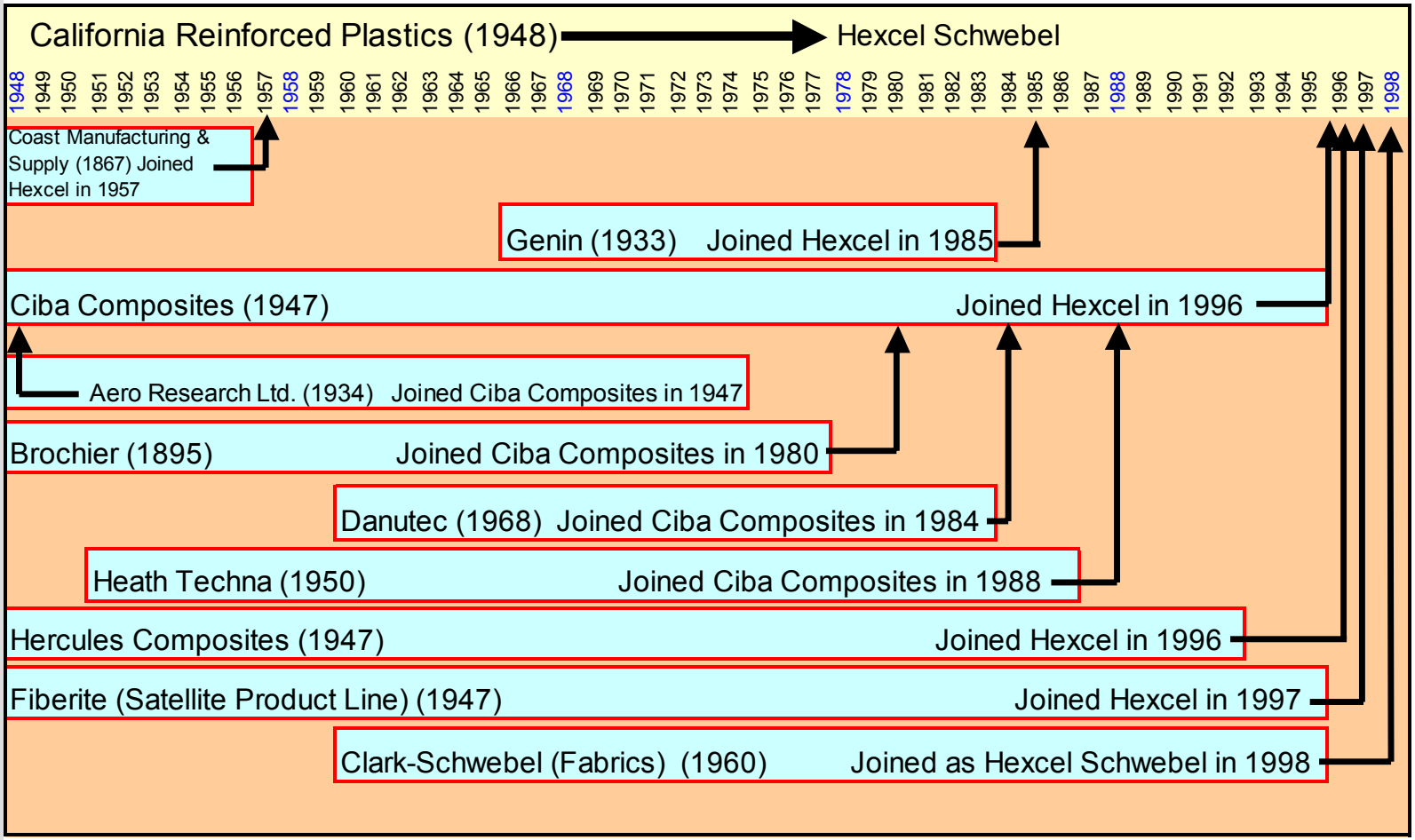
To:

Cure State

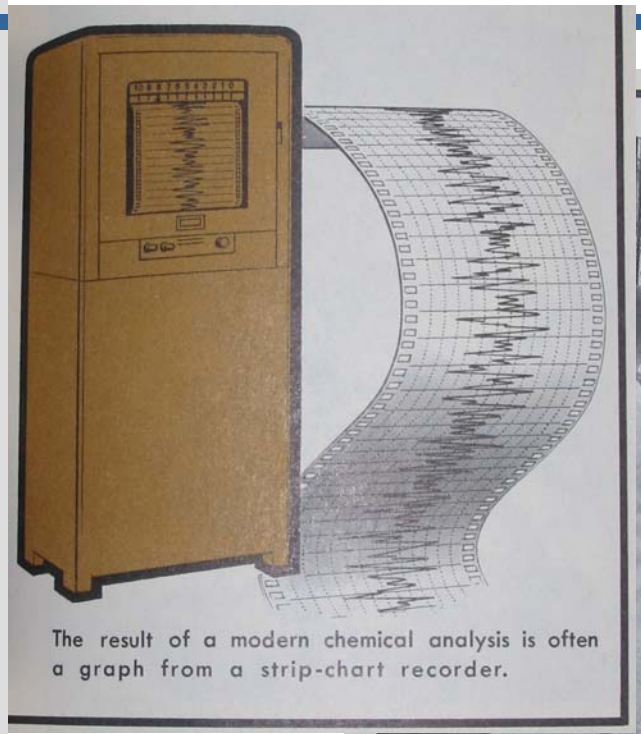
Composites Development Timeline



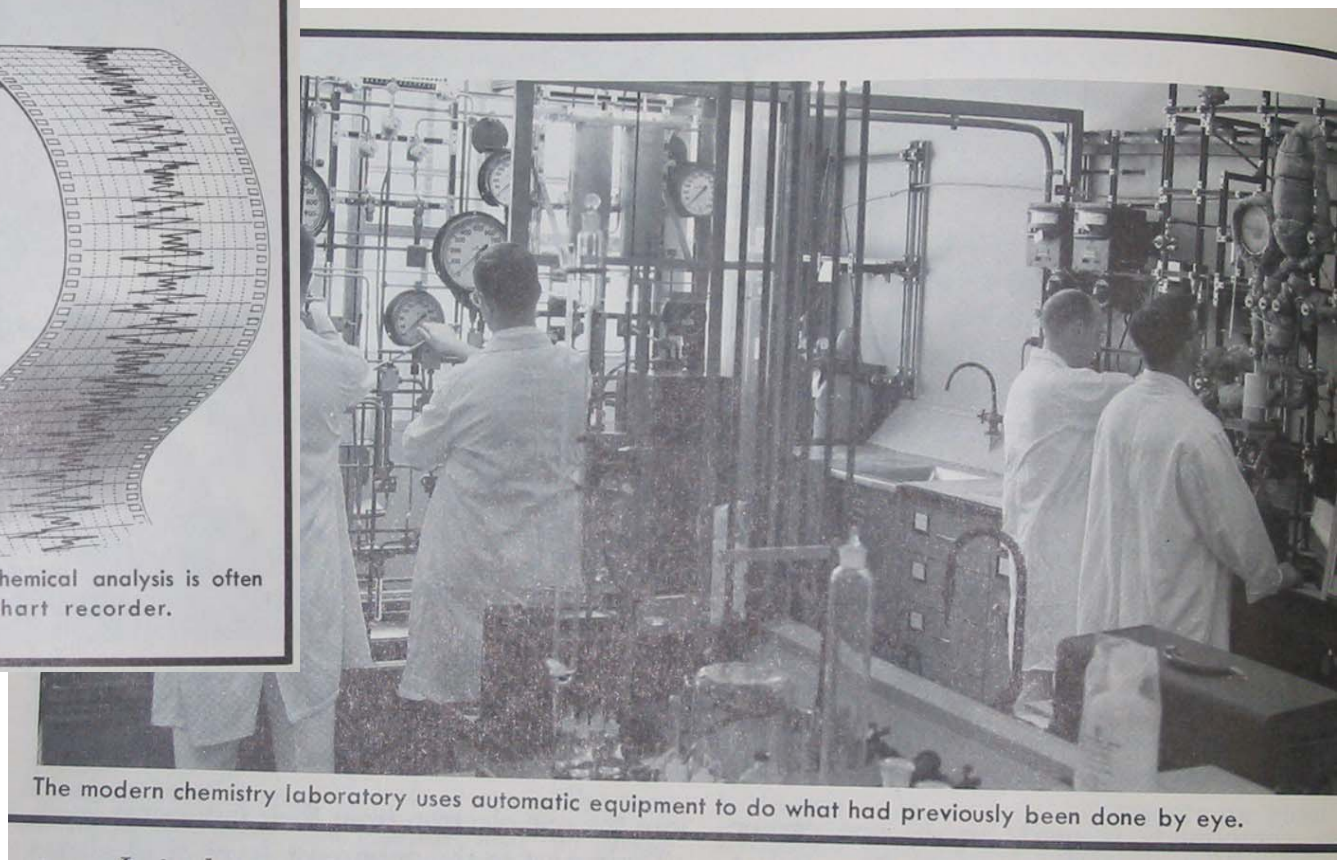
Example of Industry Consolidation



Lab Equipment Contemporary to Legacy Specification Development ca. 1971

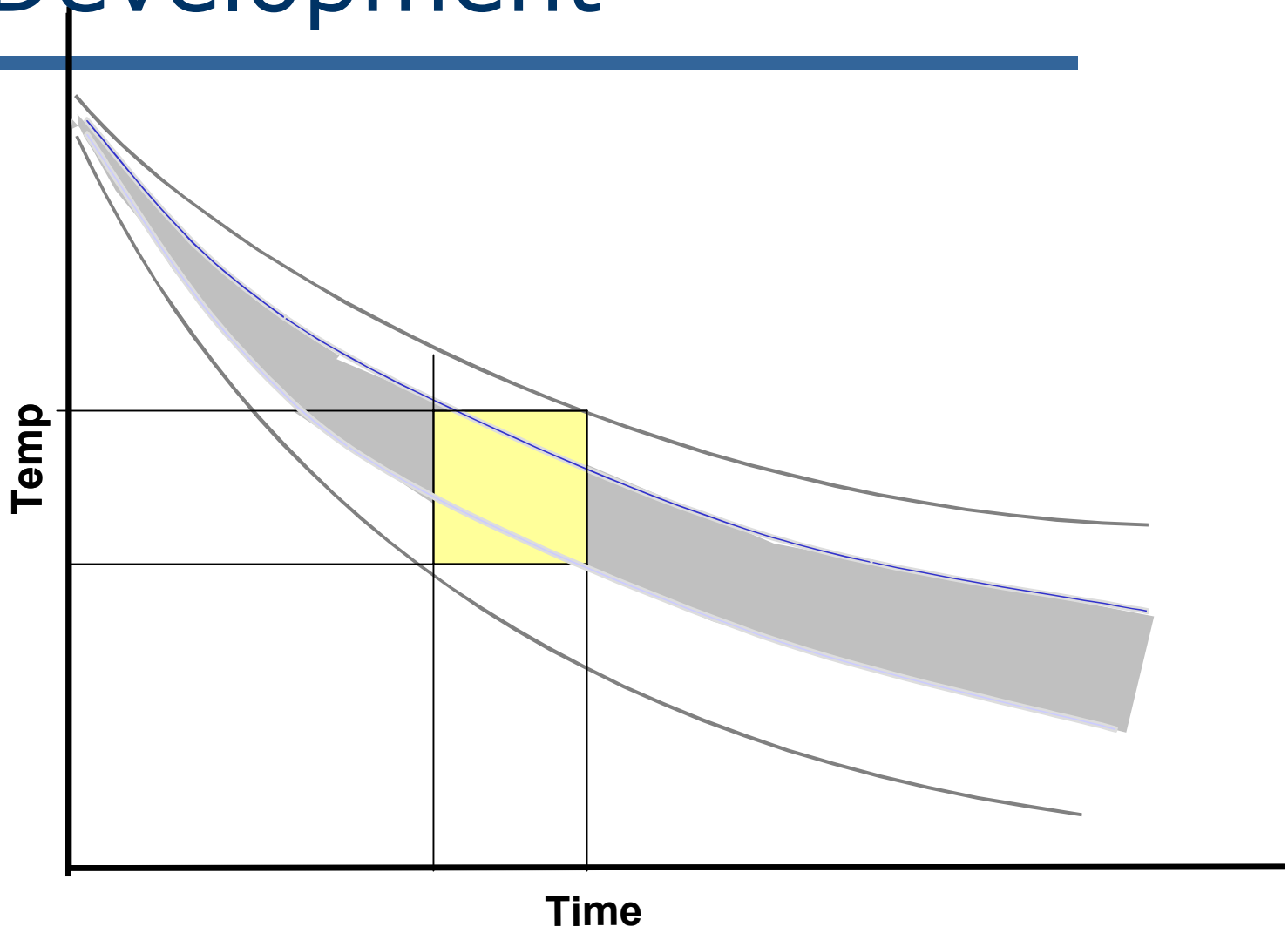


The result of a modern chemical analysis is often a graph from a strip-chart recorder.

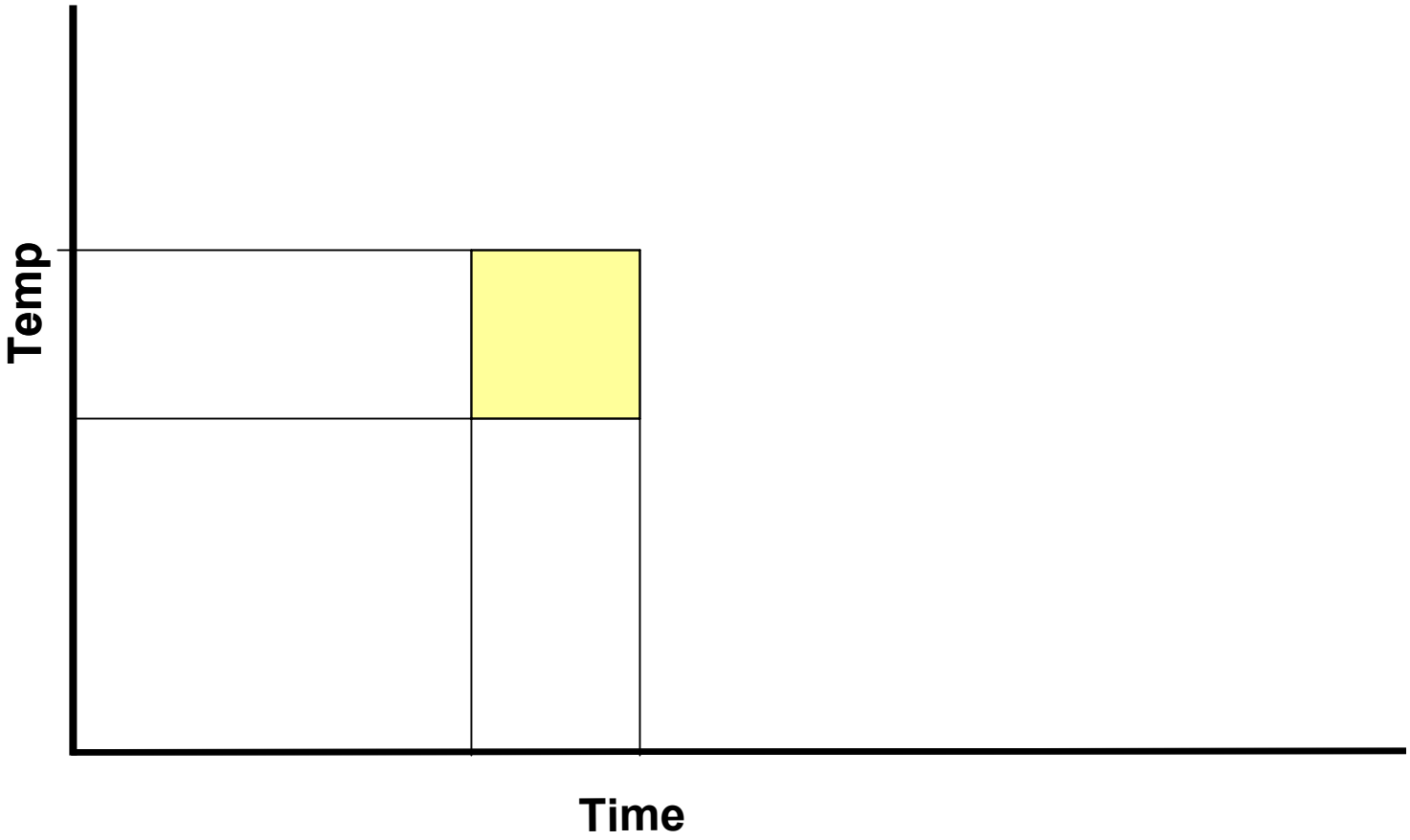


The modern chemistry laboratory uses automatic equipment to do what had previously been done by eye.

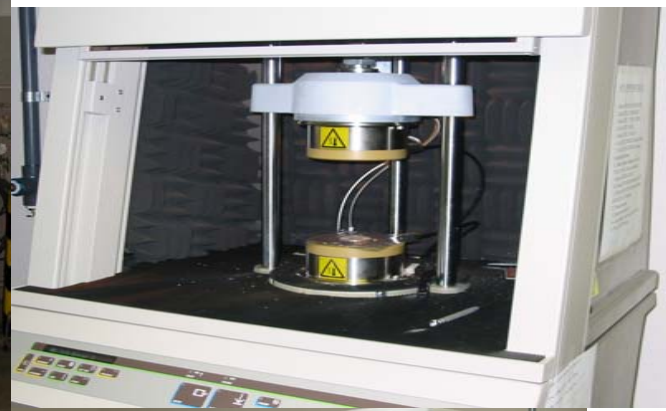
Pre-Production Process Development



Information Conveyed in Specs, T.O.'s and Shop Procedures

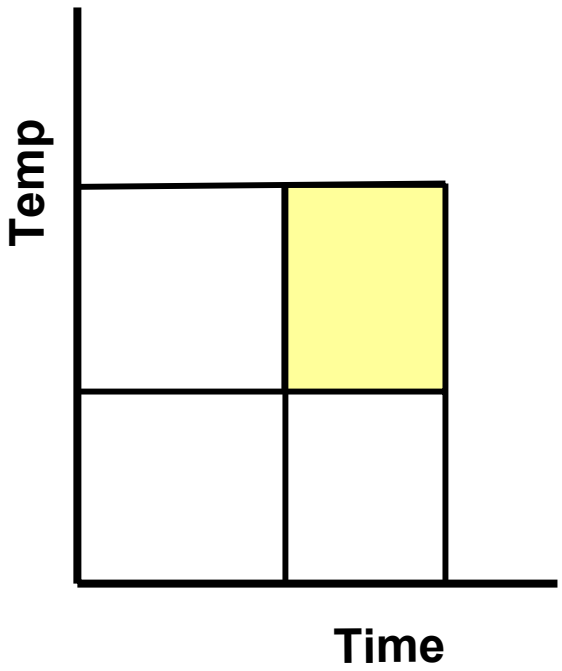


State of the Art Test Equipment and Process Controls

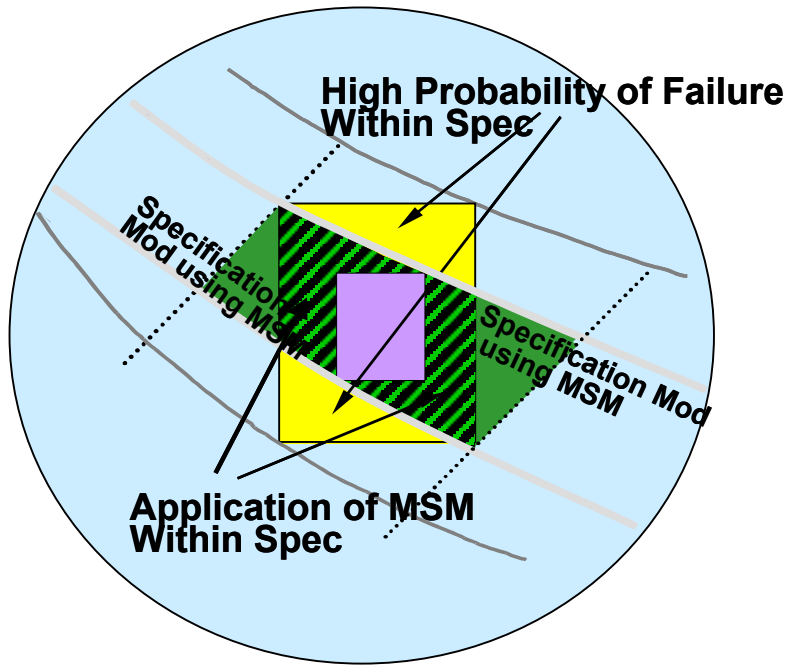


MSM Application to Spec Limits

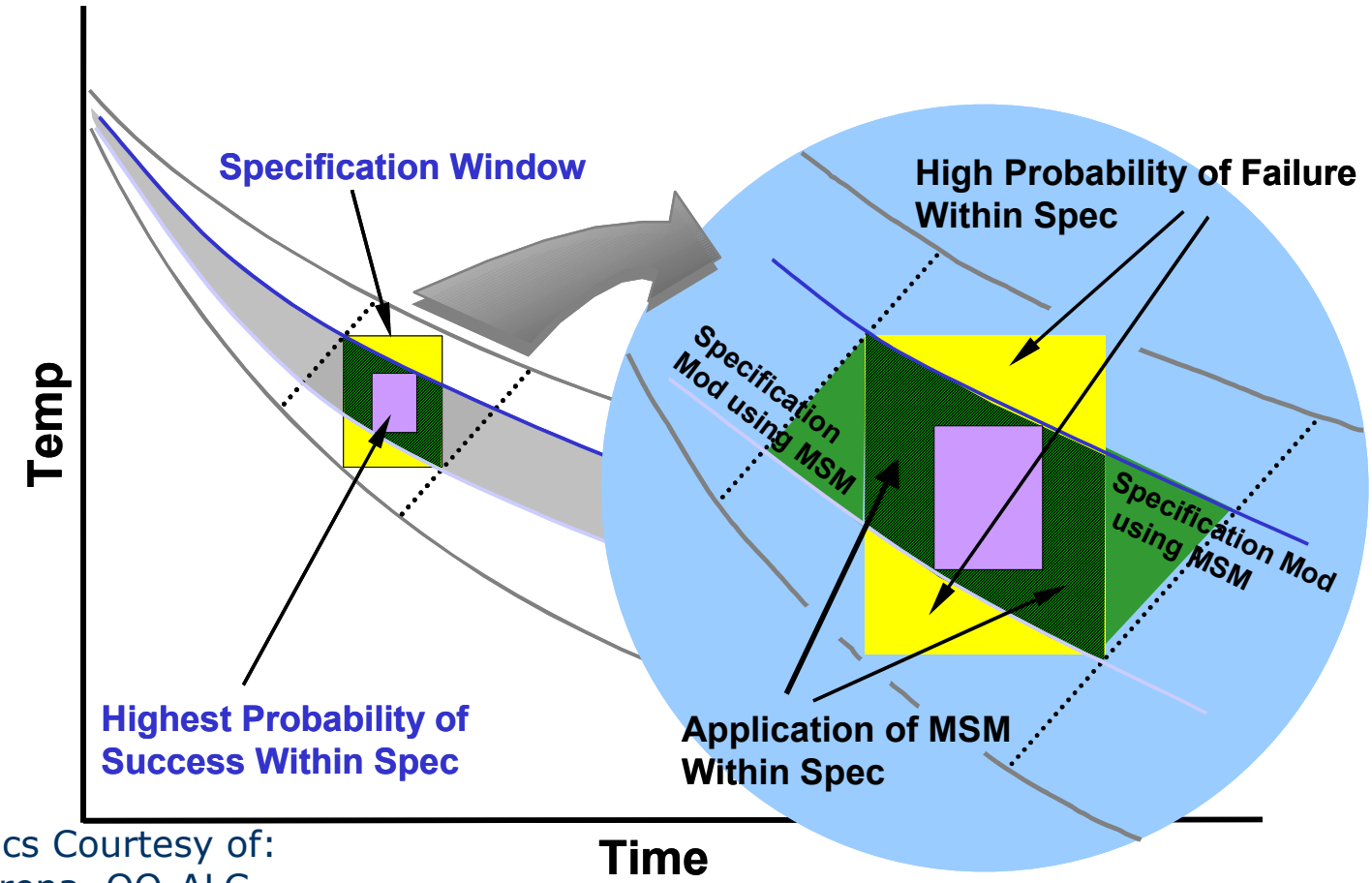
- Legacy



- MSM

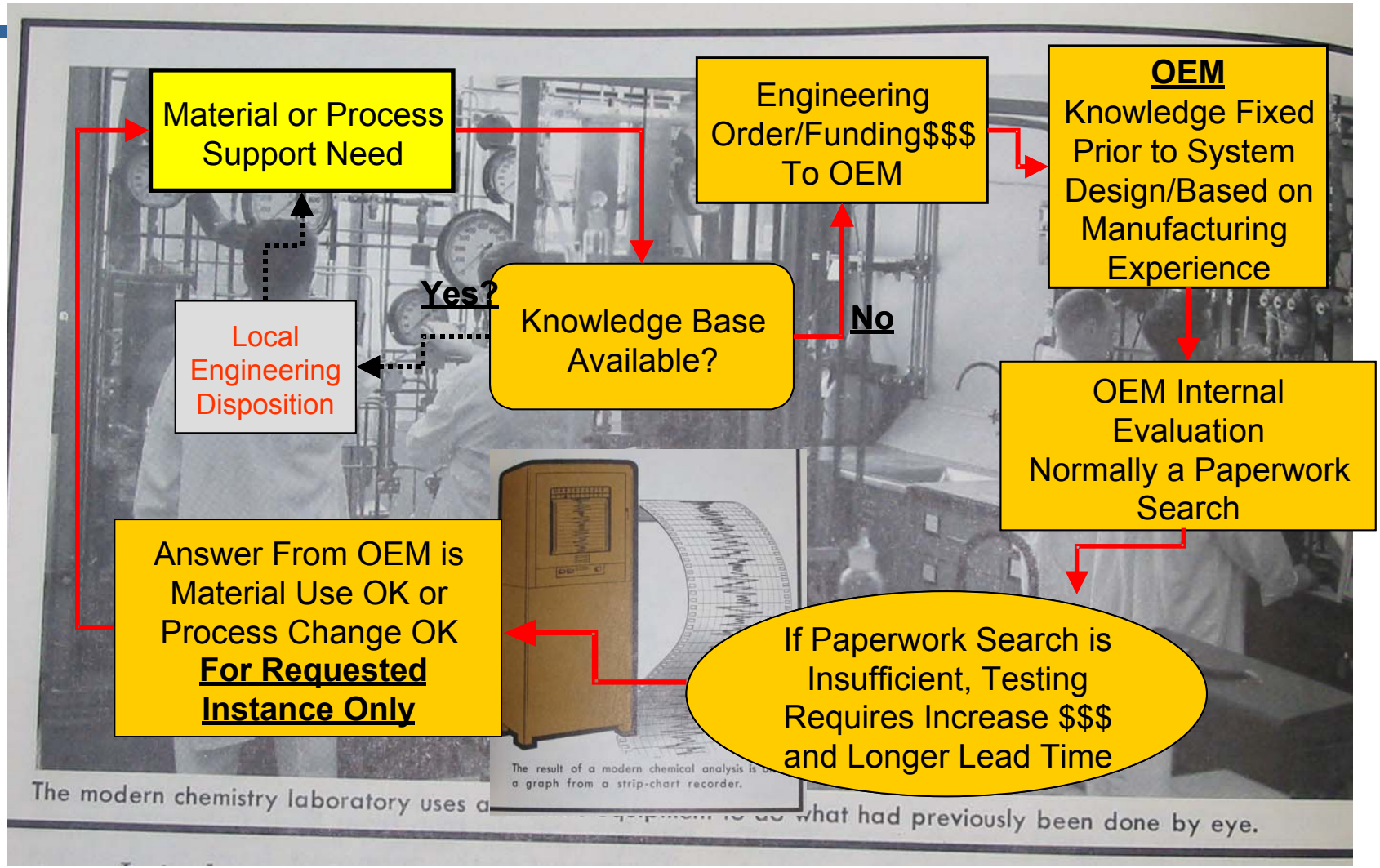


Legacy vs. MSM Processing



Graphics Courtesy of:
Mike Frena, OO-ALC

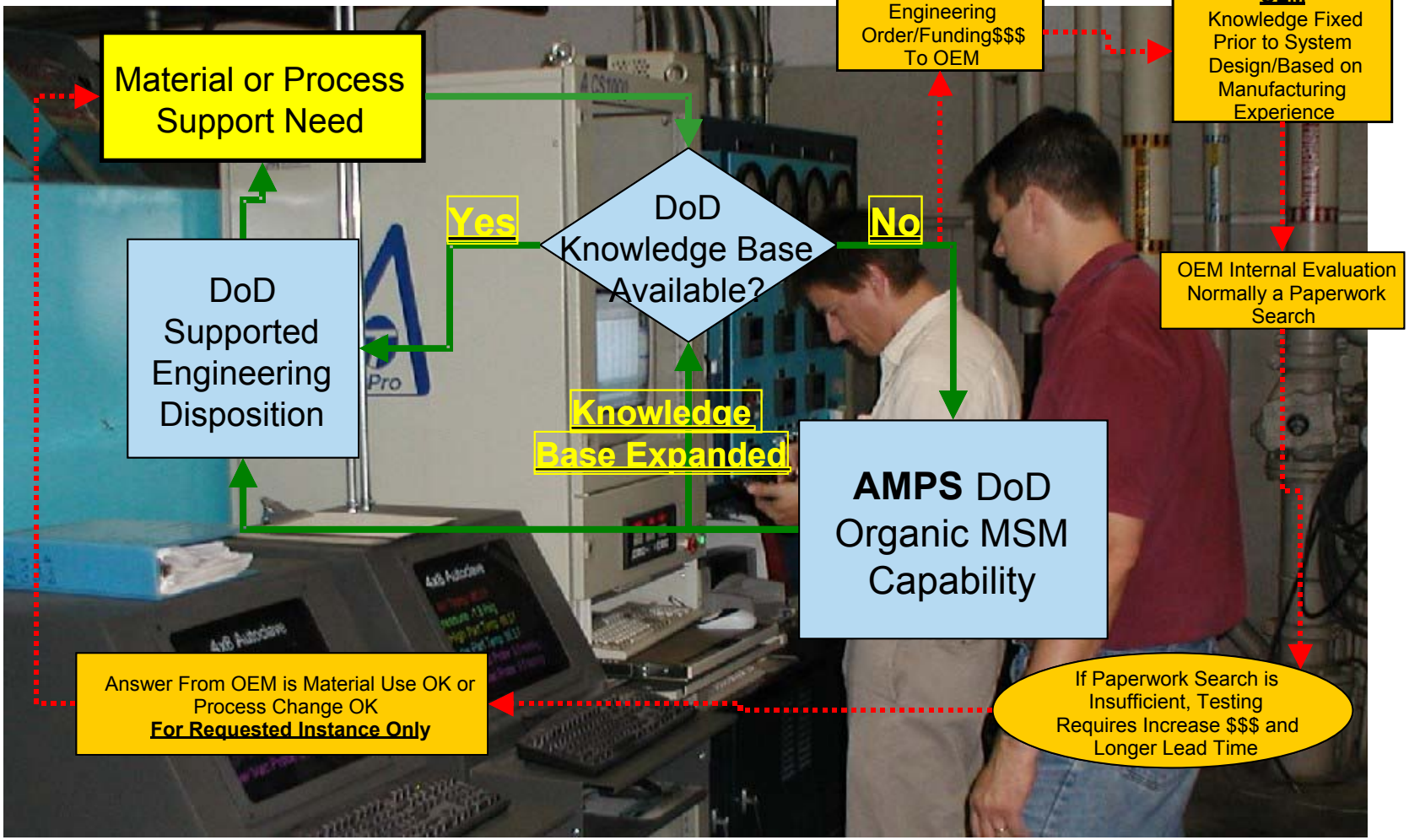
Current Support Path



Goal

- Advanced Material and Process Support (AMPS)
  - MSM Organic to DoD
  - Specs and T.O.’s MSM Based
  - Support Internal to DoD (e.g. ACO)

Advanced Material and Process Support (AMPS) Organic to DoD



Evolution to Material State Management (MSM)

Phased Approach

- Phase 1 – Identification of Potential Savings and Pilot Projects (Complete)
- Phase 2 – Methodology Development
  - Material and Process Substitution (In Development)
- Phase 3 – Coordinated Development of Data and Baseline Specifications and Procedures
- Phase 4 – DoD Wide Implementation and Continuous Improvement

Cost & Sustainability

- Cost of Current Specification Generation
  - Proprietary Multi-Million $ Qualification Program
  - Repeated for Each Application
- Material State Management Can Replace Current Method With:
  - Public Domain Specifications & Extensible Databases
  - Validated Independent of OEM

Application to Supportability & Repair

- Acceptance Based on Material Property - Not Process
  - Change of Temperature or Duration to Accommodate Repair Constraints
  - Acceptance Based on Material State Measurement or Estimate
- Design of Repair Options Increased
  - Larger Process Window
  - Easier to Avoid Faulty Performance

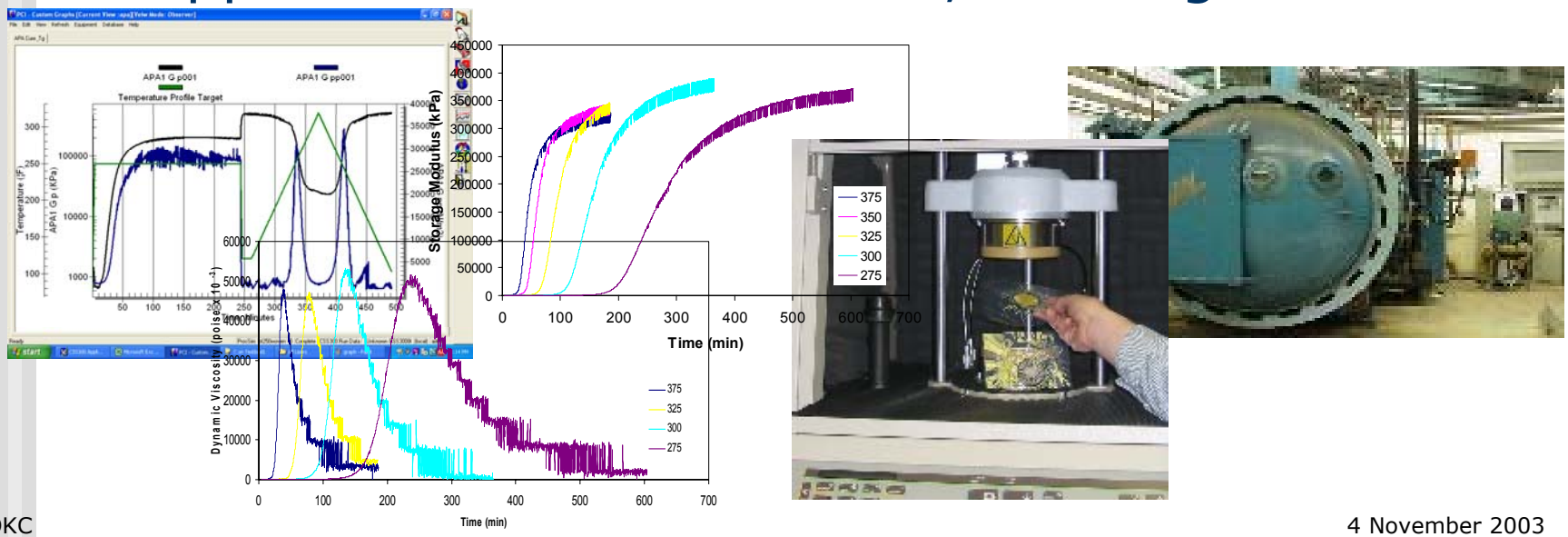
CTMA and Related Efforts

Participants

- ACO
- AvPro
- Vought/Aerostructures
- General Atomics
- OC-ALC
- OO-ALC
- CCAD
- Others

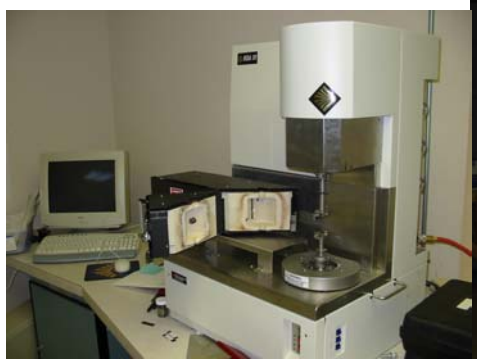
MSM Infrastructure Requirements

- Material State Targets for Processing & Acceptance
- ***Practical*** Tools for Shop Using Networks & Imbedded Knowledge
- Methodologies, Methods, T.O.'s & Specifications
- Support Activities with Tools, Funding and Charter



Shop Tools

- **AvPro CSS300 MSM Suite –**
  - **Real Tim e Feedback To/From Laboratory**
  - **Cure Models for Process Targets & QA**
  - **Heat Transfer for Repair Assessment**
- **Network Design**
  - **Profile Development for "in Shop" by Engineering**
  - **Near Real Time Load/Repair Assessment by Remote Support**



Needs for Continued MSM Development

- Support for:
  - Training Programs Development
  - Continued Shop Tool Development
  - Collaboration With DoD Internal Support Sources
  - Long Term Support, Adequate Funding, Focus on Full Implementation Goals